Helichrysum, 59; *Senecio*, 36; *Aster*, 3; with no *Solidago*, and no *Helianthus*).

Of trees there are many species, but nearly all belong to genera unfamiliar to northern readers. Thus while there are two willows (*Salix*), one *Celtis* and 13 species of *Ficus*, there is no *Pinus, Picea, Abies, Ulmus, Fraxinus, Acer, Juglans, Quercus, Fagus, Castanea, Betula* or *Alnus*.

The authors are to be congratulated upon having brought out so creditable a list of the plants of their country, and we may express the hope of the botanists of the northern hemisphere that they will be encouraged to follow it soon with a descriptive manual.

GREENE'S "CAROLUS LINNAEUS"

AT the Linnaean bicentenary memorial exercises held in Washington Dr. Edward Lee Greene gave a notable address (now issued in a little book of 91 pages by the Cower Company of Philadelphia) in which he discussed with rare perspicacity and scientific sympathy the life of "the matchless Swede," Linnaeus. In it he discussed the lineage and childhood of Linnaeus, his school, college and university years; his journey to Lapland; journey to Germany and Holland; his practise of medicine in Stockholm; appointment to be a professor at Upsala, and his influence upon botany. Under the last head Dr. Greene says:

> It will be difficult to bring the average botanist of to-day to a realization of how great an epoch in botany Linnaeus created when he began examining the stamens of every plant, with the purpose of ascertaining into what one of his twenty-four proposed classes of flowering plants each generic type must fall. And though it be true that the classes and orders of Linnaeus fell into disuse three quarters of a century ago, it is true to-day that every botanist, from the mere beginner in taxonomy to the most accomplished master of it, if he have a new and unknown plant in hand for determination, makes his final appeal to stamens and pistils. . . . In this procedure every botanist who lives is distinctly a disciple of Linnaeus.

The last chapter of the little book, on Linnaeus as an evolutionist, was prepared two years later (1909) and brings out the fact that the great botanist was by no means the believer in the "fixity of species" that we have been led to believe. After quoting from the "Philosophia Botanica" which "excludes every idea of a possibly evolutionary origin for any species of plant," Dr. Greene says: "And yet, Linnaeus was an evolutionist," and proceeds to quote later statements which indicate that as the years went on he came to the view that some species may have been derived from preceding species.

The book should be in the hands of every teacher of botany, and we may add zoology, also, since there is a short but very suggestive chapter by Dr. Wm. H. Dall on Linnaeus as a zoologist.

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SPECIAL ARTICLES

MAGMATIC DIFFERENTIATION AT SILVERBELL, ARIZ.

IN the course of a study of the ore-deposits of Silverbell, Pima County, Ariz., some interesting facts bearing upon magmatic differentiation were noted. A detailed description of this district has been published,[1] but as that paper is largely devoted to problems in economic geology, it seems advisable to summarize here the facts of interest to petrologists. The region described consists of a complex of late Mesozoic or early Tertiary intrusives entirely surrounding detached blocks of highly metamorphosed limestone. The igneous rocks in the order of intrusion are (1) alaskite, (2) alaskite porphyry, (3) granite, and biotite granite porphyry, and (4) quartz porphyry (dacite porphyry?). Many complex flows of basic composition are found just outside the area studied. The chief problem is the origin of the biotite granite, which is believed to represent a differentiation product of the magma from which the alaskites came.

The alaskite is a light gray rock, consisting almost entirely of quartz and orthoclase, the grains averaging about a half a centimeter in diameter. It contains a little plagioclase, and very rarely shows biotite or hornblende. It is bounded on one side by the later intrusion of

[1] *Bull. Amer. Inst. Min. Eng.*, May, 1912, pp. 455–507.

alaskite porphyry, but in all other directions it disappears under the detrital plains of the desert. The area exposed—about ten square miles—probably represents only a remnant of a more extensive intrusion. The alaskite porphyry, the intrusion next in age, is a rock with a fine felsitic ground mass, carrying phenocrysts of quartz and orthoclase seldom over a millimeter in diameter. It resembles the alaskite in composition, though showing more variation in kind of feldspar. An intrusive contact between the porphyry and the coarse alaskite was found, but the other limits of the porphyry do not fall within the region studied It was examined over an area of about three square miles. The biotite granite is a holocrystalline rock with an average grain of a quarter of an inch. It is composed of orthoclase, a little plagioclase, quartz and biotite, this last mineral sometimes forming phenocrysts. The relation of this granite to the other rocks is the most interesting petrologic feature of the district. It is found only in the alaskite porphyry, and occurs in three forms: (1) As irregular stocks about fifteen hundred feet in diameter, (2) as small bunches or lenses sometimes only a few feet in dimension, and (3) as well-defined dikes fifteen to twenty feet wide along the contact of the alaskite porphyry and the limestone blocks. In the first two cases the texture is holocrystalline and strikingly coarse even at the contacts. In the third case the rock is a granite porphyry—phenocrysts of quartz, feldspar and biotite in a glassy ground mass.

The fourth rock is more basic than the others, and may be a dacite porphyry, but the large amount of irresolvable ground mass makes its classification uncertain without chemical analyses.

The explanation offered for the above facts is as follows: The original rock magma was an acidic granite, which split into two parts, one rich in biotite, the other practically mica-free. The more acidic portion was intruded first, forming the alaskite and the alaskite porphyry. When the latter rock was only partly cooled, the biotite-bearing portion was intruded, working its way into the still pasty alaskite porphyry to form lenses, tongues and other irregularly defined masses. Along the borders of the alaskite porphyry cooling had gone further, clean fissures had been formed, and in such places well-defined dikes of granite porphyry resulted. This explains the intimate relationship between the granite and the alaskite porphyry, its various irregular shapes, and the coarse texture in some instances and the fine texture in others. There is a possibility that the quartz porphyry, which contains much biotite, is a still later intrusion of the biotitic phase of the same magma, but distinct evidence on this point is lacking. The relation between the quartz porphyry and the alaskites is not as close as between the granite and the alaskites. The quartz porphyry seems to belong to a distinctly later period of intrusion, while the granites and alaskites are of very nearly the same age.

Although aware of the objections urged against similar hypotheses, I am inclined to attribute the splitting of the magma into two portions to fractional crystallization and the sinking of the heavier biotite crystals. Whether or not this last point is well taken can not affect the conclusion that the granite is a later differentiation phase of the magma from which the alaskites came.

The origin of the granite has important bearing upon the genesis of the ore-deposits. These ores are contact metamorphic copper deposits in the limestones at the contact with alaskite porphyry. They are attributed to magmatic waters given off by the intrusive, in accord with the conclusions reached in similar districts by Kemp, Lindgren and others. But it is noteworthy that the richest ore is found in the neighborhood of masses of granite. Now if this granite is the final product of differentiation of the alaskite magma, it is very probable that it would bring with it increased quantities of magmatic water. The granite and the granite porphyry then partake somewhat of the nature of a pegmatite in that they represent final products of local magma splitting; they differ from pegmatites in texture, and from contemporaneous veins in general in their greater extent. The above facts

show a variation from the general law of decreasing basicity for plutonic intrusions, but this may be explained by the localized character of the phenomena.

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FERTILIZATION AND EGG-LAYING IN MICROCOTYLE STENOTOMI

ALTHOUGH the process of fertilization of the ovum is readily visible in those animals in which these elements meet outside the body in water, the actual behavior of the internal organs in those other animals where the process occurs within the body is seldom seen. It is for that reason that it seems desirable to describe it as studied in the transparent *Microcotyle Stenotomi.*

Copulation has been carefully observed and graphically described by Zeller in the case of *Polystomum integerrimum,* where the two vaginal orifices are at the lateral margins, but no other description has been found in the literature on the monogenetic trematodes, and in the case of the microcotylinæ is of special interest, since although hermaphrodites they can hardly carry out mutual copulation at the same time, as the vaginal orifice is median and dorsal while the penis is protruded from the ventral side.

Microcotyle Stenotomi, which occurs on the gills of *Stenotomus Chrysops,* is small enough (2.5 mm.) to become quite transparent when slightly compressed by the coverslip. If a number of these worms be placed alive in a watchglass full of sea water some of them will be seen to go into conjugation after certain repeated preliminary touching together of the anterior ends of the two bodies has taken place. In this passing of the anterior part of the body of one over that of the other the greatest acuteness of sensation is shown. However, after a certain amount of friction together, one worm almost spasmodically becomes fastened by its anterior ventral end, where the genital pore is situated, to the corresponding portion of the dorsal surface of the other in the position of the vaginal opening. They are therefore clasped together by the anterior ends, almost at right angles to one another, while still supporting themselves on their footlike sucker discs. Because the cirrus and surrounding genital aperture are generally provided with clusters of small hooks the pair is enabled to keep their position during the act.

The spermatozoa pass through the Y-shaped reservoir of the vitellaria to be stored in the seminal reservoir or spermatheca, whence it is ejected as required. A similar provision exists, as is well known, in many animals of more complete development.

In order to follow the later stages in the process of fertilization the worm must be put in a drop of sea water under the coverslip with a hair beside it to prevent too great crushing by the weight of the coverglass, and to allow of the normal movements of the genitalia. Anteriorly and ventrally is the genital pore through which the uterus opens. On the dorsal surface somewhat behind this is the orifice of the vagina. The ovary is a convoluted tube filled with ova which runs across the middle of the body, turning backward to end in an oviduct, while on each side of the body, occupying most of its cavity, is the vitellarium, giving off ducts which unite in a Y-shaped reservoir in the midline behind the ovary. Testes are present in a great group in the midpart of the body toward the caudal end.

In the ovary the ova are immature at the end of the organ, which is turned to the right; toward the other end, as the oviduct is approached, they become larger and mature. The oviduct may be seen proceeding toward the tip of the Y-shaped vitelline reservoir. Before reaching this it is joined by the duct of a small muscular sac which in this case is kidney-shaped and which is the seminal reservoir. If one is fortunate enough to see an ovum leave the ovary on its way toward the uterus, one can also observe that the seminal reservoir contracts spasmodically and injects a fine jet of opaline fluid into the oviduct toward the oncoming ovum, which on meeting the spermatozoa quickens its motion. It recedes a little, then advances again four or five